

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application of Takahashi et al.  
Filed: February 24, 2005  
Application Serial No.: 10/525,443  
For: **METAL SULFIDE THIN FILM AND METHOD FOR PRODUCTION THEREOF**

Confirmation No: 3864  
Group Art Unit: 1715  
Examiner: Elizabeth A. Burkhart

October 7, 2010

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Box 1450  
Alexandria, Virginia 22313-1450

**APPELLANTS' REPLY BRIEF ON APPEAL UNDER 37 C.F.R. §41.41**

Sir:

This Reply Brief is filed in response to the Examiner's Answer mailed August 11, 2010. This Reply Brief highlights how the Examiner's Answer continues to fail to establish a *prima facie* case of obviousness in rejecting the pending claims.

**STATUS OF CLAIMS**

As of the filing date of this Reply Brief, claims 1, 8, 10, 11, 13 and 15 are pending. Claims 2–7, 9, 12 and 14 are canceled. Claims 1, 8, 10, 11, 13 and 15 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Takahashi et al. (2000) *J. Mater. Sci.* **10**:2346–2348 (“Takahashi et al.”) in view of Sasaki et al. (1999) *J. Mater. Sci. Lett.* **18**:1193–1195 (“Sasaki et al.”). The specifics of this rejection are set forth in the Final Office Action mailed August 24, 2009 (“the Final Action”) and the Advisory Action mailed October 30, 2009 (“the Advisory Action”). Appellants appeal the final rejection of claims 1, 8, 10, 11, 13 and 15.

**GROUND'S OF REJECTION TO BE REVIEWED ON APPEAL**

Whether claims 1, 8, 10, 11, 13 and 15 are unpatentable under 35 U.S.C. § 103(a) over Takahashi et al. in view of Sasaki et al. as set forth in the Final Action and the Advisory Action.

**I. The Examiner's Answer – Response to Arguments**

Appellants will refrain herein from readdressing all of the deficiencies with the pending rejections and, therefore, in the interest of brevity, Appellants hereby incorporate herein the arguments set out in

Appellants' Brief on Appeal of March 15, 2010 ("the Brief") as if set forth in their entirety. Appellants believe that the Board may find this helpful in evaluating the propriety of the pending rejections.

In the "Response to Argument" section beginning on page 4, the Examiner's Answer attempts to rebut Appellants' arguments set forth in Sections III and IV of the Brief. Appellants will respond to the arguments in the Examiner's Answer for this section below.

**A. The Rejection of Claims 1, 8, 10, 11, 13 and 15 over Takahashi et al. in view of Sasaki et al.**

On page 4, the Examiner's Answer asserts that Sasaki et al. teach that "high partial pressure of sulfur and high temperature can be a critical factor to prepare pure pyrite and once these conditions are satisfied, pure pyrite phase can be prepared by other methods. The Fe/S flux ratio and temperature were adjusted to form a marcasite- and pyrrhotite-free pyrite film. A pure pyrite film may be formed at temperatures higher than 300°C and at a Fe/S flux ratio higher than 6.8 (p. 1193-1195)" (see, page 4, first paragraph of the Examiner's Answer). It is this assertion on which the Examiner bases her argument regarding teaching, suggestion and motivation to prepare a pure pyrite film at a temperature according to the method as instantly claimed.

The fact that an invention employs known elements does not preclude patentability. It is the claimed combination of elements which is the proper basis for review. "Virtually all inventions are necessarily combinations of old elements." *Panduit* at 1575 (citing *Medtronic, Inc. v. Cardiac Pacemakers, Inc.*, 220 USPQ 97, 99-100 (Fed. Cir. 1983)). Indeed, the Federal Circuit has stated (in regard to an obviousness-type invalidity challenge to an issued patent) that "[t]he notion, therefore, that combination claims can be declared invalid merely upon finding similar elements in separate prior patents would necessarily destroy virtually all patents and cannot be the law under the statute, § 103." *Panduit* at 1575. Furthermore, as stated in *KSR Int'l Co. v. Teleflex Inc.*, "[a] patent composed of several elements is **not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art**" (emphasis added). *KSR Int'l Co. v. Teleflex Inc.*, 550 U. S. 1, 15 (2007). In *KSR*, the Supreme Court also made clear that predictable variations are likely obvious, but unpredictable variations are not:

If a person of ordinary skill can implement a predictable variation, § 103 likely bars its patentability. For the same reason, if a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill. *Sakraid* and *Anderson's-Black Rock* are illustrative - a court must ask whether the improvement is more than the predictable use of prior art elements according to their established functions.

KSR at 1740.

The Court also recognized that when the prior art taught away from the claimed invention, the invention was more likely to be non-obvious: “when the prior art teaches away from combining certain known elements, discovery of a successful means of combining them is more likely to be nonobvious.” KSR at 1740 (citing *United States v. Adams*, 383 U.S. 39, 51-52 (1996)).

The Court also emphasized the importance of identifying “a reason” that a person of ordinary skill in the relevant field would have combined the elements in the fashion claimed by the new invention. *Id.* at 1731. The Court also emphasized that **this analysis should be made explicit**:

Often it will be necessary for a court to look to interrelated teachings of multiple patents; the effects of demands known to the design community or present in the marketplace; and the background knowledge possessed by a person having ordinary skill in the art, all in order to determine whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue. To facilitate review, this analysis should be made explicit.

*Id.* at 1740–1741 (citing *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006)).

Appellants respectfully reiterate that the pending claims are patentable over the cited references for at least the reason that the present rejection does not provide the requisite suggestion or incentive to combine the cited prior art, with a predictable and reasonable expectation of success, to arrive at the recitations of the pending claims.

The Examiner continues to submit that, so long as the variables of temperature and Fe/S flux ratio are sufficiently high, a pure pyrite film may be prepared by “other methods” of deposition as allegedly suggested by Sasaki et al. At temperatures higher than 300°C (573 K) and at an Fe/S flux ratio higher than 6.8, Sasaki et al. do disclose that a pure pyrite film may be prepared by a method other than MOCVD, i.e., a double-source evaporation method *in vacuo* using elemental iron and sulfur, with the condition of high partial pressure of sulfur and high temperature.

The Examiner alleges that Sasaki et al. teach that only temperature and partial pressure of sulfur are critical variables, and because Sasaki et al. do not disclose that pressure and choice of reactants are critical, (*see*, page 5, lines 10–16 of the Examiner’s Answer) the Examiner thus broadly concludes that the teachings of the prior art indicate that only sufficiently high temperature, partial pressure of sulfur and Fe/S flux ratio are critical to the formation of a pure pyrite film, and that no other variables are critical or have an effect on forming a pure pyrite film. Appellants respectfully submit that this conclusion clearly contradicts the general knowledge within the art.

Although a claimed invention is likely to be obvious if it is a combination of known prior art elements that would reasonably have been expected to maintain their respective properties of functions after they have been combined (*Sundance, Inc. v. DelMonte Fabricating Ltd.*, 550 F.3d 1356 (Fed. Cir. 2008), Examination Guidelines Update: Developments in the Obviousness Inquiry After KSR v. Teleflex, Federal Register 75(169):53643–53660 (2010)), such is clearly not the case here. As one of skill in the art will appreciate, **it is not reasonable to expect that the requirements for the variables of temperature, reactant partial pressure and Fe/S flux ratio to maintain similar properties given a change in pressure when preparing a pure pyrite film.**

The instant claims under appeal include variables, pressure under which the deposition occurs and choice of reactants, that clearly differ from the method of Sasaki et al. By suggesting that the difference in these variables from the prior art is not critical to differentiating that which is claimed from the prior art, Appellants submit that the Examiner is improperly disregarding elements that comprise the claimed invention. These elements clearly differentiate the present invention. It is the claimed combination of elements which is the proper basis for review. Furthermore, based on the conclusions as set forth in the Examiner's Answer discussed above, the Examiner is suggesting that altering variables such as pressure and reactants will have no critical effect on the temperature or reactant partial pressure requirements of a vapor deposition method. Yet, as one of skill in the art will appreciate, it is clearly understood that the temperature requirements for a chemical reaction or process are not unaffected by changes in pressure, and in fact it is unreasonable to expect that changing pressure will have no effect on other variables. Clearly, water boils at a lower temperature at altitude and lower pressure than it does at sea level. Thus it might be expected that a higher temperature may be required for a reaction that occurs at atmospheric pressure than *in vacuo*. Yet the Examiner, in her consideration of the claims, is suggesting that since the disclosures of Sasaki et al. lack explicit discussion of the effect of the variable of pressure on the process for preparing a pure pyrite film, the variable of pressure is thus not indicated as critical and thus does not alter the conclusions regarding the variables that the Examiner has “cherry-picked” as being the only critical factors related to the claimed method for preparing a pure pyrite film.

Appellants reiterate that the disclosures of Sasaki et al. provide no suggestion of what a “sufficiently high” temperature, partial pressure of sulfur and Fe/S flux ratio are for “other methods” of vapor deposition, nor do the disclosures of Sasaki et al. provide sufficient guidance for one of ordinary skill in the art to predictably determine the same with a reasonable expectation of success, given the variables that differ between the instantly claimed method and the teachings of the prior art. There is no indication in the disclosures of Sasaki et al. regarding how the quantitative values of Fe/S flux and partial pressure of sulfur set forth in the method of Sasaki et al. will predictably correlate with the requirements

for methods for forming a pure pyrite film using the completely different reactants ( $\text{FeCl}_3$  and  $\text{CH}_3\text{CSNH}_2$  of the instantly claimed method vs. elemental Fe and S for the method of Sasaki et al.), such as those of the instant claims. Furthermore, by the admission of the Examiner in her Answer, Sasaki et al. is silent regarding the effect of varying pressure, i.e., *in vacuo* vs. atmospheric pressure, on preparing a pure pyrite film and its effect on the requirements for temperature, Fe/S flux and partial pressure of sulfur when preparing a pure pyrite film by vapor deposition. Yet the Examiner has concluded that varying pressure is not critical to the instantly claimed method.

In spite of the prior art providing no teaching regarding the conditions and variables noted above that differ between the instantly claimed method and the disclosures of the prior art, the Examiner nevertheless leaps to the conclusion that Sasaki et al. teach that at temperatures higher than 573 K and at a Fe/S flux ratios higher than 6.8, any other method of vapor deposition, including the method as instantly claimed, will be obvious and result in a pure pyrite film. However, as one of skill in the art will appreciate, temperature, Fe/S flux ratio, partial pressure of sulfur and pressure, as well as the particular reactants used, among others, are all variables that must be taken in account in a method for preparing a pure pyrite film and that these requirements for any one of these variables will change given a variation in another one of these variables. One of skill in the art will also appreciate that it is clearly not reasonable to conclude that “sufficiently high” temperatures and Fe/S flux ratios will remain the same for other methods, when there is a change in pressure, such as with an atmospheric pressure CVD method, compared with a low pressure/*in vacuo* vapor deposition method described by Sasaki et al.

While it may be that a pure pyrite film can be prepared so long as sufficiently high temperature, partial pressure of sulfur and Fe/S flux ratio are maintained, the disclosures of Sasaki et al. also indicate that **marcasite has a tendency to form at temperatures below 723 K** when using MOCVD (*see*, p. 1193, col. 1, fourth paragraph of Sasaki et al.). Clearly, Sasaki et al. thus teach that for at least one “other method,” i.e., MOCVD, a “sufficiently high” temperature for preparing a pure pyrite film is greater than 723 K. As set forth in the Examination Guidelines Update: Developments in the Obviousness Inquiry After KSR v. Teleflex, Federal Register 75(169):53643–53660 (2010), a claimed combination of prior art elements may be nonobvious where the prior art teaches away from the claimed combination and the combination yields more than predictable results (*Crocs, Inc. v. U.S. Int’l. Trade Comm’n*, 598 F.3d 1294 (Fed. Cir. 2010)). When taken as a whole, while Sasaki et al. may suggest that a “sufficiently high” temperature and Fe/S flux ratio are critical for forming a pure pyrite film, Sasaki et al. clearly do not predictably suggest that temperatures above 573 K and Fe/S flux ratios greater than 6.8 are suitable conditions for all other methods of vapor deposition for preparing a pure pyrite film. In fact, Sasaki et al. clearly **teaches away from using temperatures below 723 K** with at least one other method of preparing

a pure pyrite film, and that temperatures below 723 K clearly may not be “sufficiently high” for other methods of preparing a pure pyrite film.

Takahashi et al. describe a method for preparing a pure pyrite film using atmospheric CVD and  $\text{FeCl}_3$  and  $\text{CH}_3\text{CSNH}_2$  as reactants. Takahashi et al. note that a pure pyrite film may be formed by the method described therein at temperatures between 723 and 773 K. By the admission of the Examiner, Takahashi et al. do not teach a method of preparing a pure pyrite film at temperatures of 375–425°C (648–698 K) as instantly claimed. While the teachings of the prior art indicate that the temperature must be sufficiently high in order to enable one to prepare a pyrite film free of marcasite by vapor deposition, the teachings of Takahashi et al. do not suggest that a pure pyrite film may be formed at temperatures below 723 K with rapid growth rates (see, p. 2348, Conclusion of Takahashi et al.) and do not suggest that 648–698 K is a sufficiently high temperature to prepare a pure pyrite film without the formation of marcasite. The disclosures of Sasaki et al. clearly teach that marcasite has a tendency to form at temperatures below 723 K with the preparation of pyrite films by MOCVD as discussed above. As such, Appellants reiterate that the disclosures of Takahashi et al. and Sasaki et al. do not teach and in fact teach away from using temperatures below 723 K to prepare a pure pyrite film for at least some methods of preparing a pure pyrite film. Thus, when considering the teachings of the prior art as a whole, particularly in view of the numerous variables that are involved and requiring consideration with the described methods of vapor deposition for forming a pure pyrite film, i.e., temperature, reactants used, pressure, partial pressure of sulfur, Fe/S flux, etc., Appellants assert that the disclosures of Takahashi et al., Sasaki et al. and the knowledge in prior art at the time the invention was made, do not provide the requisite teaching, motivation and suggestion, with a reasonable and predictable expectation of success that the temperatures of the instantly claimed method (648–698 K) are “sufficiently high” to produce a pure pyrite film, and in fact the disclosures of Takahashi et al., Sasaki et al. and the knowledge in prior art at the time the invention was made provides evidence and discussion that reasonably teaches away from using the temperatures of the instantly claimed methods to prepare a pure pyrite film.

Thus, Appellants respectfully assert that the Examiner has failed to make a *prima facie* case of obviousness, and that claims 1, 8, 10, 11, 13 and 15 are patentable over Takahashi et al. in view of Sasaki et al. In view of the foregoing, Appellants submit that the rejection with respect to the pending claims should be reversed for the reasons discussed herein and in Appellants’ Brief.

**CONCLUSION**

In light of the entire record and the above discussion, Appellants respectfully submit that Claims 1, 8, 10, 11, 13 and 15 are patentable over the cited references. Accordingly, Appellant respectfully requests reversal of the rejection of claims 1, 8, 10, 11, 13 and 15 and that this case be passed to issuance.

It is not believed that an extension of time and/or additional fee(s) are due. Appellants believe this amount to be correct. However, the Commissioner is hereby authorized to charge any additional fee, which may be required, or credit any refund, to our Deposit Account No. 50-0220.

Respectfully submitted,



F. Michael Sajovec  
Registration No. 31,793  
Attorney for the Appellants

**Customer No. 20792**  
Myers Bigel Sibley & Sajovec, P.A.  
P. O. Box 37428  
Raleigh, North Carolina 27627  
Telephone: (919) 854-1400  
Facsimile: (919) 854-1401

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Marthenn Salazar